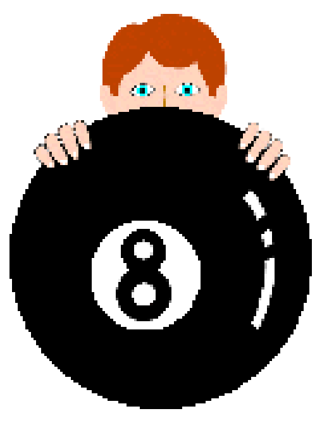
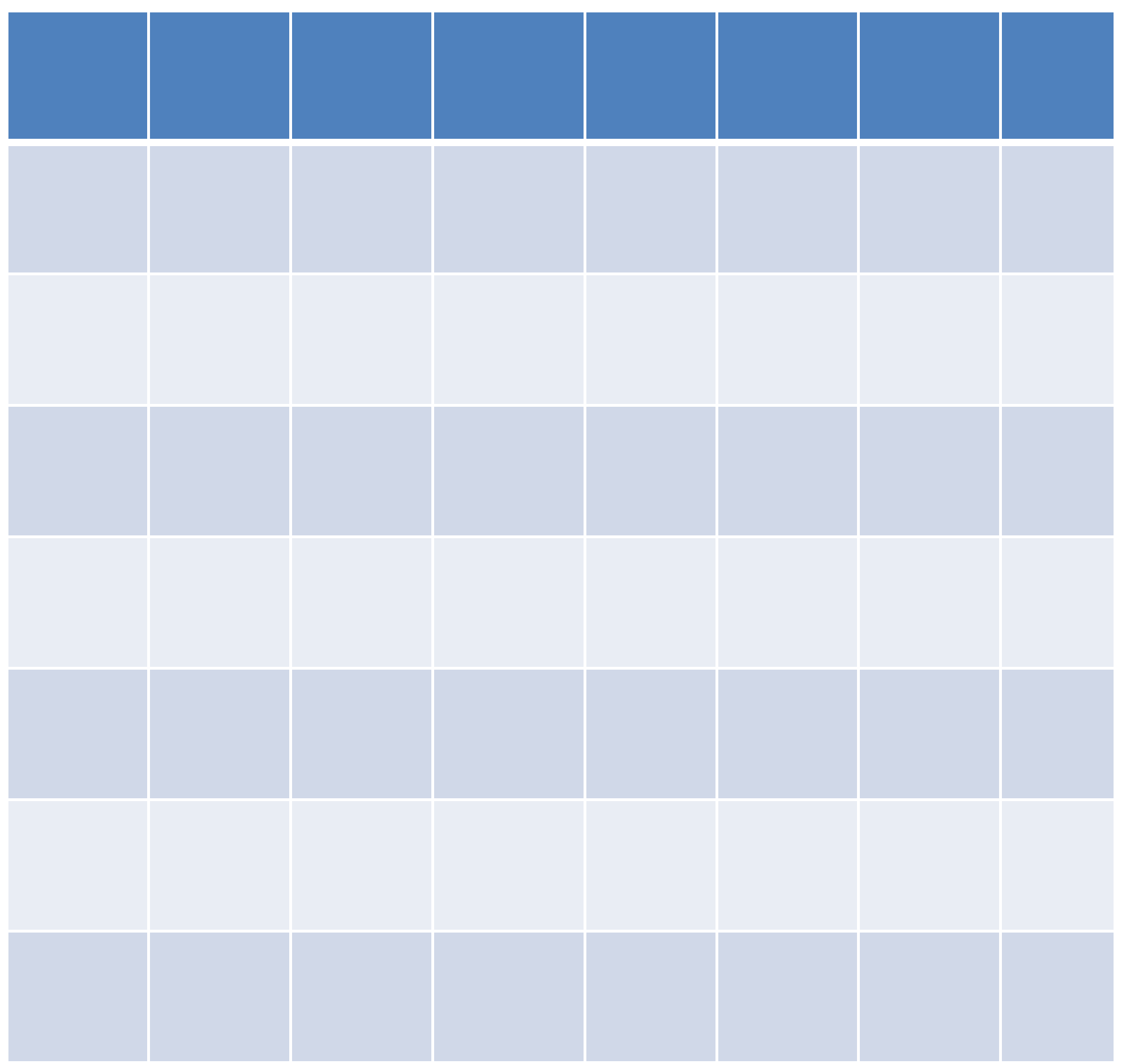
Reflections of a Test Engineer

Irony of Test: In many places



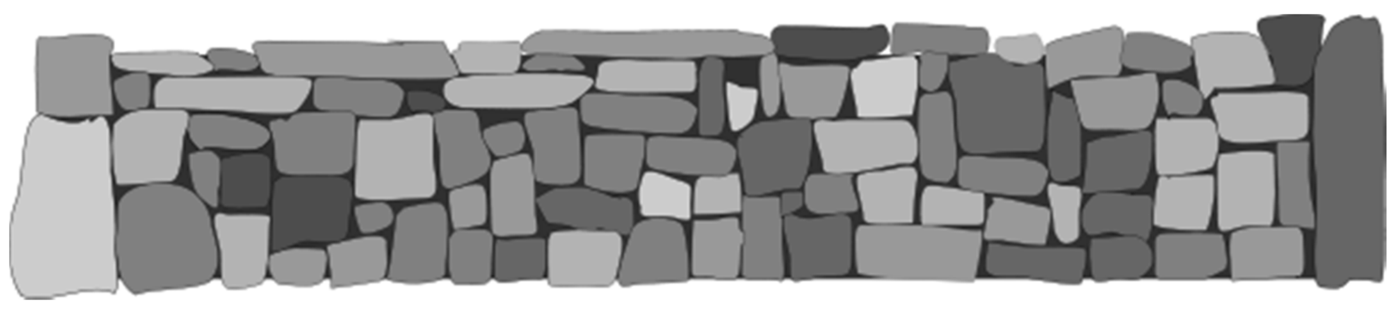
- Test is viewed as a necessary(?) evil.
- Test – like quality – appears to increase cost.
  - Cost of conformance vs. Cost of Non-Conformance
- If a test finds a problem – that's bad! If it doesn't find it – it is worse!!!!
- Test is one of the last items on the agenda => sometimes asked to absorb earlier schedule slips.
- Recently I have seen articles suggesting that test is being used as a method of product differentiation. -- a selling point.

Text Elements- Complexity



QUESTION:
For simplicity sake, an 8 x8 array is shown. How would you test it?

What is wrong with writing a 1 to each cell; reading a 1 from each cell ; writing a 0 to each cell; and then reading back a 0 from each cell?



Permutations and Combinations provide an un-surmountable wall!

Many memory test patterns exist.

Test Elements – Test Control

Inadequate test control can result in failed or intermittent tests. This can cause lack of confidence in the test or the test system and allow test escapes to be made Without test control, a test system is "lost in the woods". **The test system cannot share control!**

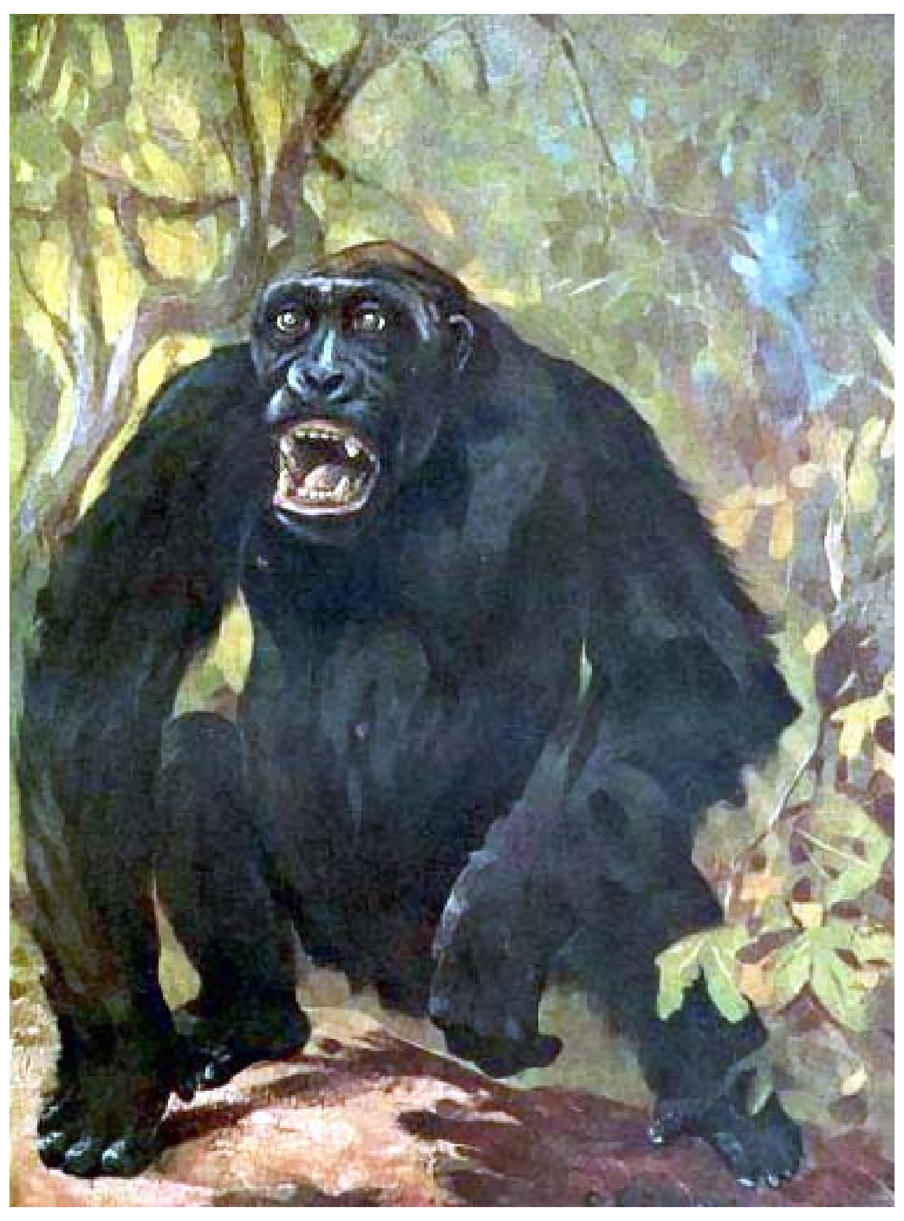
Item	Comment
What	What input(s) or variable(s) is(are) to be modified. It must be capable of holding the others constant.
How	The test system must have a mechanism to change the system and/or provide the proper input.
Why	The test procedure/case should make it clear WHY this change or input to the system is being made.
When	The test system must control when changes are made to avoid race conditions in the test.

Test Elements – Test Timing

Jitter" or variation in the timing of a test system can result in:

- Tests that are not repeatable, intermittently fail, etc.
- Tests that actually pass (OR always fail), because the inputs were not processed in the proper order.

Common View of a Test Engineer



- Software testing is not about proving conclusively that the software is free from any defects, or even about discovering all the defects. Such a mission for a test team **is truly impossible** to achieve. Rex Black, Pragmatic Software Testing , John Wiley & Sons 2007
- Its your job to find and report significant bugs. But **you won't find all of them**. To find all of them, you'd have to look everywhere there could be a bug, and you'd have to look there under every different situation that could arise, and you'd need a foolproof way of recognizing every different kind of bug when it occurred. If you think you can do that , you have either a very simple product or a very limited imagination. Lessons Learned in Software Testing, Wiley Computer Publishing 2002
- The purpose of test planning therefore is to put together a plan which will deliver the right tests, in the right order, to **discover as many of the issues with the software as time and budget allow.** Nick Jenkins, A Software Testing Primer, http://www.nickjenkins.net [NOTE: this definition allows that time and/or budget can become an issue. -- cda]
- It takes **imagination, persistence and a strong sense of mission** to systematically locate the weaknesses in a complex structure and to demonstrate its failures. Software testing in the Real World, Addison-Wesley 1995

Test is a risk reduction technique.
There is still a little black magic involved in test creation.

Test Elements - References

Public References

IEEE 829-2008
DO-178B/DO-178C
IEEE 1012
UL Standards
Legal

Private References (such as)
Company proprietary
Textbooks
EXPERIENCE

Just when you think you've graduated from the school of experience, someone thinks up a new course. ***- Mary H. Waldrip***

References Are Important – Because:

Question 1, what is the software supposed to do.
Question 2, what is the software not Supposed to do?

Standards mandated by law
NASA Policy Directives
NASA Technical Standards
NASA Contract Requirements
Other Government Standards
National or International Consensus
Standards recognized by Industry

WPClipart
http://www.wpclipart.com/index.html

Charles D. Adkins Friday, August 15, 2012

Reflections of a Test Engineer

Test Elements – The Three Questions

Test is to help ensure that:

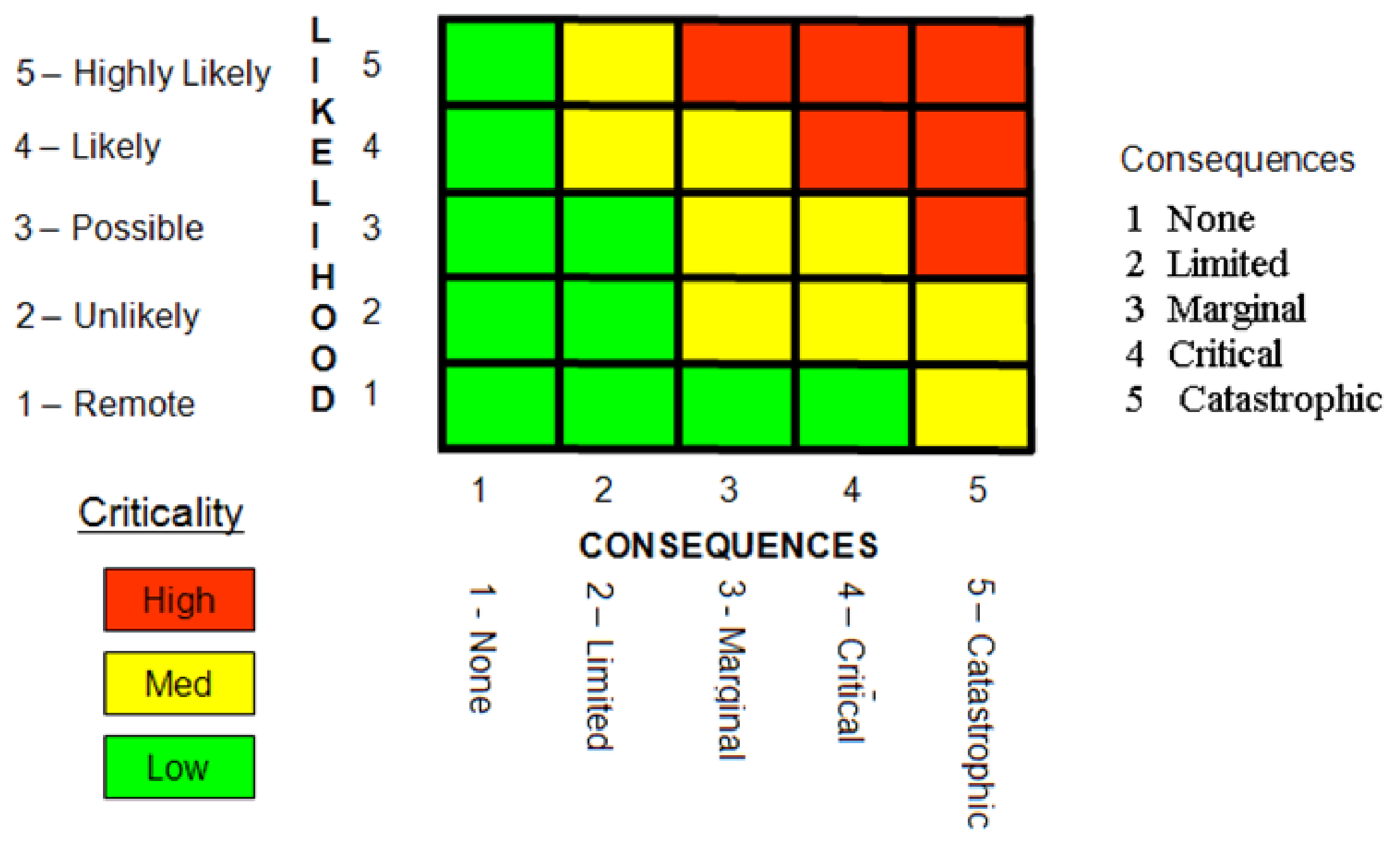
- The System (software) does what it is supposed to do.
  - This one is easiest of the three – does it meet requirements?
- The System (software) does not do what it is not supposed to do.
  - This one takes more thought , What can go wrong? What shouldn't it do?
- The system (software) responds appropriately to/under adverse conditions?
  - This one takes even more thought. What is "appropriately"?
- Ray Arell asks the question – "**Would you be willing to be your first customer**?" in the book Quality through Change-Based Test Management.

Test Elements – Test Equipment

Computer	Instruments	Environmental	Software
Test Controllers	Standard Test Equipment	ESD/EMI/RFI	Emulation Simulation
Test Monitors	JTAG	Pressure	Languages
User Interface	Emulators Simulators	Temperature	In-House Developed
Log Files	Power Supplies	Humidity	Scripting, standard And custom
Configuration Mgmt	Data Acquisition	Vibration	Development Platforms
SPR Tracking	Protocol Analyzers	Shock	
….	Custom	Corrosion	

Test Element - Software Integrity Levels and Risk

IEEE Std 829-2008	DO-178B	NPR 7150.2E Appendix E
Level 4–Catastrophic 3–Critical 2–Marginal 1–Negligible	**Class** A Catastrophic B Hazardous/ severe-major C Major D Minor E No Effect	**Class** A Human Rated Space SW systems B Non-Human Space Rated SW Systems or Large Scale Aeronautics Vehicles C. Mission Support SW, Aeronautic Vehicles, Major Engineering/Research Facility SW D. Basic Science / Engineering Design and Research and Technology SW E. Small Light Weight Design Concept and Research and Technology SW F. General Purpose computing SW (Multi-Center or Multi-Program/Project) G. H General Purpose Desktop SW



Test appropriately to the required level

Test Element – Test Techniques Defined

Test Technique	Comment
White box	Requires knowledge of unit under test.
Black box	Test from external point of view.
Exploratory	Usually ad-hoc, experimental.
Boundary Testing	Verifies boundary conditions.
State Testing	Verifies state entry/exit conditions.
Logic testing	Verifies decisions.
Requirements Testing	Requires tests to trace to requirements.
Path coverage	Verifies each path (and statement) is executed. May not detect missing code, timing issues, hw/sw compatibility, configuration, memory leaks, other …
Load, Stress, Performance, Robustness	Tests designed to push a system to some limit, such as throughput.
Automated	Usually required for the load testing.

Test Element – A Few Test Types Defined

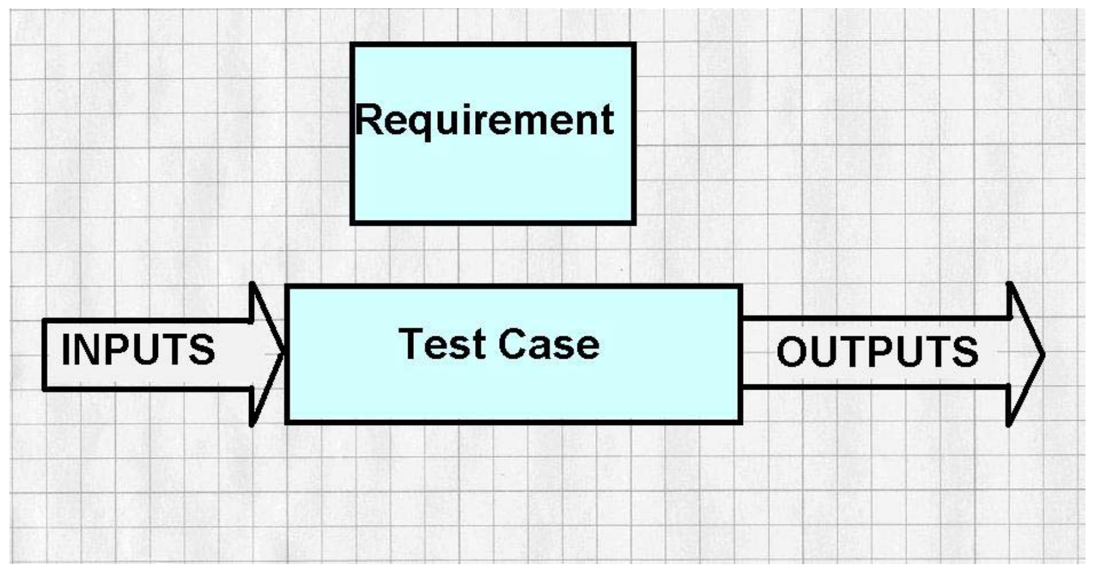
Hardware	Unit
Component	Integration
Module	DVT
Component	Acceptance
System	Regression
Software	Manufacturing
Diagnostics	Built in Self Test (BIST)
Load, Stress, Performance, Robustness	
…..	………

Hardware Test Types Defined by DO-160-F

Functional **Temperature** **Temperature variation** **Humidity** **Operational Shock** **Vibration** **ESD** **Magnetic Effects** **Electrical Disturbances**	**Radio Frequency susceptibility (radiated and conducted)** **Power Interruptions and variations** **Contamination** **Altitude (pressure)** **Lightning** **Life**

Test Element – Test Artifacts

- The Master Test Plan
- Lower Level Test Plans
- Test Procedures/Test Cases
- Test Oracle
- Traceability (RTM)
- Test Report
- The Test System

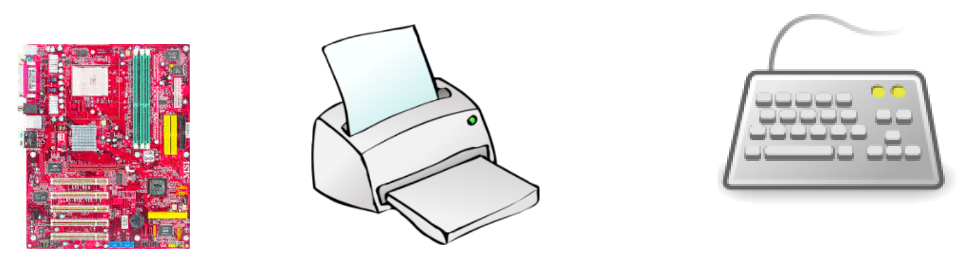


Evaluating a Test Case

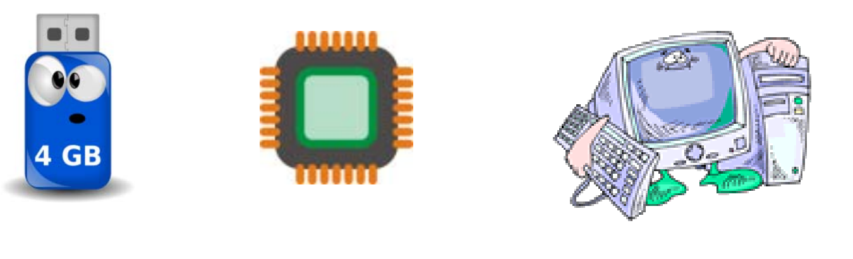
Do Normal Inputs produce normal outputs? (Question 1)
What could the system do wrong? (Question 2)
What can influence the output? [bad inputs, an interrupt, …] (Question 3)

Correct	Clear	Consistent	Complete	Req. Covered	Repeatable	Robust
Is the test verifying the right response?	Can the test be understood? Is it clear, concise?	Is the test consistent with other tests and with the requirements?	Does it test everything that it should?	Are other tests needed to complete test of the requirement?	Does the test provide the same results when executed repeatedly?	Does it look at adverse events,

Watch Terminology! -- What does THIS project define as a module?



Watch Terminology! -- What does THIS project define as a component?



Thanks for stopping by!

Charles D. Adkins Friday, August 15, 2012